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ABSTRACT

The paper examines the applications of microcomputers to recreation programing for blind persons. The accessibility of microcomputers to this population is discussed, and the advantages as well as disadvantages of speech synthesis equipment are noted. Information is presented on the modification of hardware for Radio Shack and Apple computers. Sources for software, including local computer libraries, mail order houses, and public libraries are listed. Suggestions for using computer games in recreation for the blind include beginning with games that involve easily recognized speech. Benefits for the instructor are seen to include ease of planning and recordkeeping. The paper concludes with a list of games, their status (public or commerical), a brief description, and a list of 11 vendors and their addresses. (CL)

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THE COMPUTER AND RECREATION

BY
PAUL EDWARDS

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INTRODUCTION

Anyone foolish enough to be involved in recreation for the blind already knows that it is virtually impossible to devise activities that meet the needs of a broad cross-section of the blind community. What is good for the congenital with good braille skills leaves the newly-blinded partial out in the cold. What is good for the high partial is impossible for the total. At best, then, recreational programming for the blind is an exercise in futility. At worst, it just doesn't work. The harder you try, the fewer people you seem to satisfy. Recreation is one of the hardest activities to organize and, because students are not in centers to play, it is at the low end of a list of priorities that is miles long. This factor combined with the relatively low pay available to recreation people helps to explain the high turnover rate in this profession. This paper offers no panaceas but suggests that the advent of the microcomputer might make a serious difference in the continuing struggle to provide quality recreation at an affordable price to the agencies footing the bill.

This whole paper is really no more than an introduction and it will probably be more valuable for the references that it contains than for any intrinsic value it might have. If it does no more than awaken recreation people to the fact that the computer can work for them as well as for other professionals, it will have served one of its main purposes. It is also important to recognize that a paper of this length can do little more than scratch the surface of this huge subject. More significant, it is probable that at least some of what I am about to say will be out-of-date by the time I have discussed it. I suspect that parts of this paper will seem to tantalize you with a promise that they quickly hedge around with provisos. I am not doing this on purpose. One of the sad truths concerning computers and the blind is that there is no national clearing-house of information or any authoritative book on this subject. There is also no standardization in language between most competing computers. There are programs for the Apple which do not exist for the Radio Shack computer and vice versa. Programs written for one computer will not run on competitors' machines. As if this were not discouraging enough, add the fact that some computers work better for the blind than others and things really start getting complex. It is also relevant to add that the author of this paper has limited experience. Effectively, then, all of

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what follows will refer to the trs80 and the Apple computers.

Computers and the Blind: An Overview

While it is possible that some of you have huge mainframe computers at your disposal, I dare conjecture that most of you will be lucky if there is a microcomputer anywhere in the neighborhood. Thus, all that follows will refer to microcomputers and the emphasis throughout will be on the least expensive and most widely accessible adaptations. I grant that this is a somewhat short-sighted approach to take since some of you work in institutions where there may be piles of adaptive equipment. If this is the case, there is also probably someone who can help you learn how to make the stuff work together effectively.

This section will aim to provide a general overview of how microcomputers can be made to work for the blind. When a product is mentioned, the address of the vendor will not be given. Instead, all the vendors discussed will be alphabetically listed at the end of the paper. In that listing, the product that is being discussed will be shown in parentheses after the name of the vendor.

In order that what follows can be more easily understood by the computer neophyte, it is necessary to define a few terms. At its simplest, a computer is a machine which has the ability to store information in its memory and follow instructions that it is given. Give a computer one set of instructions and it will behave like a calculator. Give it another set and it will play a game with you that is graphics-oriented like pac-man or a complex, text-oriented game that involves escaping from dangerous castles and figuring out how to kill monsters. Each set of instructions is called a "program" and these will usually be available in one of three formats. The easiest to explain and the hardest to use are programs that are in books. These need to be typed onto the computer keyboard. This causes the program to be stored in the computer memory. Unless you are really fond of typing, you will want to save the program in one of the other two media. Since it would be silly to expect a computer to remember every set of instructions it could possibly be given, programs are stored either on tape or on diskette. Most microcomputers can use either of these media depending on which device they are equipped with, at the time. For tape storage, a fairly ordinary cassette recorder is used. Once a program has been typed into the computer, you can save it on tape and put it back into the computer from tape, when you are ready to use it again. Tape has some real disadvantages and, more and more, micros are being equipped with disk drives. These devices use flat, square, envelopes that contain a round, magnetic

disk which is used for storing programs. Disks can load programs much faster than tape can and can list the programs that are on each disk. These factors make the disk far easier to use and far better.

Much of the time, you will not need to be concerned with typing programs into the computer because you will be using programs that have already been written and tested and put either onto tape or diskette already. These can be purchased from a number of retail stores who stock such things. Any local computer dealer will be able to give you information about where they are. Often you will not need to purchase programs at all since diskettes and tapes can usually be borrowed and copied from local computer libraries or from people who have the programs you want.

Now that everybody knows what a computer is, what programs are and how they are stored, we can proceed to discuss making computers and programs accessible to the blind. This is not a simple matter and should be tackled one problem at a time. It is now possible to make most micrmcomputers communicate in braille. However, because of the relatively small number of blind persons who can use braille and the high cost of devices such as the Versabraille or the Microbrailler, this approach should not be considered unless the equipment is already available. It has the other major disadvantage of limiting access to the computer to one person at a time. It is possible to alternate readers for complex games or to have one person responsible for reading while another does the typing in of commands. This still leaves quite a few people out of things. Large-print has the same disadvantages though, perhaps, more people can see the screen. Most microcomputers have inexpensive programs that will enable them to produce large print but this is not always readable by the visually impaired. There are two terminals that can be connected to microcomputers, one made by Apollo and the other made by visualtek. But, again, these are fairly pricey and somewhat inadequate solutions.

Despite some shortcomings that will be described later, the best approach to computer accessibility lies through speech. One of the biggest advantages of speech is that it can be used by all clients of an agency except for the deaf-blind. Another advantage is that, without question, speech is the cheapest way of making microcomputers usable by the visually impaired. A third plus comes from the fact that there is coming to be an increasingly large market for speech synthesis equipment among the general public which means that there are new products being announced quite frequently. Competition, then, is causing the cost of speech synthesis to come down dramatically.

The first device to hit the market was the type an' talk. It has recently been joined by a big brother called the Personal

Speech System which is more sophisticated and slightly more self-contained. Both these devices have the advantage that they will work with most microcomputers but have the distinct disadvantage that they must be mated to the computer using a 25-wire cable. This sounds simple enough, but can be a real pain. Every computer company connects their plugs differently and you will need help getting the type an' talk or the p.s.s. to work with the computer you are using. The manufacturers know that they have not done a good job providing interfacing instructions for their products and are trying to improve this. They have a toll-free number and are willing to provide a cable that is ready to plug into the computer you are using which, if it is wired right, should eliminate most of the problems.

The second major speech synthesizer is called the echo ii and was originally designed for use with the Apple computer. If you are using an Apple, it is unquestionably the way to go. It is a little harder to learn to use, but works very well. Late last year the echo ii was joined by a big brother of its own called the echo ii gp which is supposed to be usable with virtually any microcomputer. I have had no experience with the gp and cannot say whether it works well.

Now that I have sold all of you on speech synthesis as the way to go, I had better tell you what some of the disauvantages are. It should be noted that many of these problems will apply to any of the modes of making computers accessible and are not simply applicable to speech. The biggest disadvantage is the hardest to explain. When microcomputers were new and everyone was excited, programs were being produced and copyrighted and nobody thought that there would be a problem with people trying to steal free copies of programs. As time went on, it became clear that there was a problem. People who had spent months and years writing complicated programs found that they could sell a few of them but, very soon, they began to see their programs appearing in pirated form. Since the pirates had much less invested in the programs, they could sell them for less. One thing led to another and, right now, companies probably spend as much time protecting their programs from unauthorized copying as they do writing them. For reasons that are beyond the scope of this paper, a great deal of the commercially available software is simply not usable by the blind regardless of the equipment that is purchased. There are several groups that are urgently negotiating with computer software manufacturers so as to change this awful state of affairs; and there are some companies that have been prepared to help. The blind constitute such a small market though that there is not a lot of incentive for companies to tear apart their elaborate precautions to make their disks usable by the blind.

an initial disadvantage of speech is that it takes blind persons a little time to get used to listening to the somewhat

unclear pronunciation that current synthesizers produce. This can be alleviated by having someone read from the screen portions that aren't clear, for the first few days that the program is being used.

The final disadvantage that should be pointed out concerns the conflict that exists between a speech-oriented program and efforts to make a program look nice on the screen. Sometimes programmers use boxes of asterisks or xes to surround titles. This has the effect of causing the speech program to read each and every x or asterisk that makes up the box. This can be really annoying and can slow down the operation of a computer program a lot. If you know someone who is good at programming and you can get into the program, it is easy to change it so the box disappears. A similar difficulty concerns the fact that most speech programs either ignore or hang up on graphics. Luckily, the former is usually the case but, for example, some dice games use graphics commands to draw dice and show the numbers generated as if they were dice sitting on the screen. It is usually necessary to go into such programs and change them so that the numerals are printed as well. This will ensure that they are read by the speech program. Obviously, this is easier said than done but you will usually be able to find someone in your area who has enough experience with programming to make the simple changes that can make such programs accessible to the blind.

Interfacing Trs 80 and Apple Computers

This section does not pretend to provide a detailed step-by-step discussion of the set-up of speech-oriented systems for the Radio Shack or Apple computers. However, in fairness to those who may be aiming to acquire a new system, I felt that a brief analysis of what would be involved and an analysis of some of the sources of information on microcomputer adaptation were necessary.

Virtually all of my experience with the Trs 80 computer has been confined to the model iii. While I have also worked somewhat with the model i, I do not know nearly as much about how that machine ticks. I have had no experience with either the model iv or the model 100 though enquiries suggest that many of the problems that made earlier Radio Shack products hard to work with, have been solved brilliantly by these machines. At bottom, all Radio Shack computers suffer from the same disadvantage, however. Because they are hard-wired and designed with somewhat arcane protocols, they will only work in conjunction with products specifically designed for use with them. This limits the user to equipment which is usually designed with little concern for its impact on the blind. Whereas the Apple computer company has chosen to design a basic product and has encouraged other companies to market peripheral

equipment for use with their computer, the manufacturer of Radio Shack computers has made it almost imperative that Radio Shack equipment be used throughout. Thus, for most users, the fact that the model iii did not hand-shake effectively, was not important. For a blind user this deficit is critical. Hand-shaking involves the ability of computers and products connected to them to send back and forth to each other signals that ensure that no data is lost. If you think of the cable connecting the computer to a speech synthesizer or versabraille as an intersection and the information passing across as traffic, handshaking is like a traffic light that tells information when to stop and go. Without effective hand-shaking, one or other machine will either stop working or lose data. It is my understanding that the model iv and the 100 hand-shake well and many of the difficulties I am describing may not apply to them. Using the p.s.s. synthesizer with even the model iii works fairly well because of the large buffer memory that is built into the synthesizer. Only really complex games that are text-oriented should prove difficult.

To sum up the situation with Radio Shack, then, it should be possible to use any of the three speech sythesizers with the model iv and the model 100. The model iii should be used only with the p.s.s. synthesizer or with some other system that has a large buffer so that hand-shaking will not be a problem. Because of the use of a control n control o protocol in some terminal applications, the Radio Shack is also somewhat problematical where braille interfacing is concerned. All of this said, I must tell you that I much prefer the editing features of the Trs 80 computer to those of the Apple. Because of this, while I have chosen to use an Apple at this point, I would urge some of you to investigate the possibility of other machines including the new Trs 80s before investing in the Apple.

Having just said that, I must also say that there is no question that the Apple has more adaptive programs written for it than does any other computer. In addition, interfacing with other equipment has worked beautifully and I have not heard of any piece of equipment that could not be made to work with theApple. The 2e computer is extremely comfortable to use and its increased capacity makes it very attractive. Interfacing equipment is still no fun though, and I would urge all of you to acquire the interface guide published by Raised Dot Computing if you are just starting out with the Apple. The echo ii speech synthesizer simply plugs into one of the slots at the back of the computer and is the only additional, special item you need to buy to get going with your students. If you plan to use braille equipment, I would recommend that you acquire either the Super Serial Card for around $200 or the California Computer Systems Ccs 7710 serial card that is considerably cheaper. If you will be using an Apple ii or a ii plus, you will need to buy a ram card to store the program that runs the echo ii synthesizer. This runs around $100. Please note that the echo ii can be purchased by blind individuals for $99 from

Volunteer Services for the Blind in Philadelphia.

This section will certainly not be sufficient as a guide to what is out there and how you should use it. It will hopefully save you some time and research, though, and the vendor list at the end of this paper should give you the resources you need to contact, before getting started.

SOFTWARE

So far discussion has centered on the hardware and firmware that you need to make computers usable by the blind. This section will focus on the various programs that you can use with the computer once you have it set up and working. As I implied earlier, this is not a simple matter. The first part of this section will explore in more detail the sources for information about software, while the second will list some of the available programs and what they do.

For the record, a program that is presented in writing, on tape or on disk is said to be software. So when you are looking at a software catalog, you will need to notice what formats the program can be ordered in. Usually, a print version is cheaper but will need to be typed into the computer before being stored on disk or tape. The next cheapest is tape, but it is slower and harder to copy than disks. If your system can handle disks, I would strongly urge you to acquire all your software as disks. Be sure that the first thing you do when you receive a new disk is to back it up, that is, copy it. Disks are becoming more and more reliable, but will all eventually wear out. It is essential that you make back-up copies of all games and programs so you can use those and store the masters. It's a good idea to start keeping a print index of the programs you own and on which disk they are located, too. It may seem a little tedious to do this when you first start; but when you have spent half an hour checking fifty or sixty disks looking for something, the advantage of your index will be obvious. Most computers have software available that will allow you to store and enter the index onto disk so that you can begin by booting your index disk and entering the title you're seeking. The system will tell you what disk it's on and you can take it from there.

Since this paper is concentrating on recreational computer use, it will not discuss most special software resources for the blind. One deserves mention because it offers some recreational programs as part of its software package. These games have been selected because they are suitable for play using the echo ii synthesizer in conjunction with an Apple computer. This firm is called Computer Aids Inc. and is located in Fort Wayne IN. Games in this package range from Bingo to Lunar Lander; from an e.s.p.

test to an adventure game where you are seeking to find the legacy of a millionaire who left his fortune to anyone who could open his safe. In addition, there are educational games and a speech-oriented version of Blackjack.

As far as I am aware, this is the only source for software that has been specifically screened for its effectiveness for blind users. Obviously, there are many other games available that can be played very competently by the blind and I will append a list of some of them to the end of this paper. Games like pac-man, chess and checkers are not well-suited to the blind though they do exist for most computers. Number games, word games and complex text-oriented adventures work very well. My list includes some from most categories and I have included a brief description of the category into which each game fits.

It is necessary now to introduce a new concept. This paper has discussed already the tendency of software producers to protect their disks from copying. This has resulted in seriously limiting access to perfectly playable games because it is impossible to alter these games without recourse to their manufacturers. However there is an increasing body of what is called "public domain" software, that is, software which its writer gives everyone permission to use. This is not only accessible, it is also cheap or free. On the list of games at the end of this paper, I will indicate whether a program is public domain or commercial. I will also mention the computer on which it works. As was suggested earlier, this list will only refer to games written for Radio Shack and Apple computers since these are the only ones with which I have had experience. If this paper does good, it will be the beginning of a long series of documents that will outline more sources and will speak to the accessibility of the ibm PC, the Commodore and the Texas Instruments computers.

Local computer libraries and an increasing number of public libraries are sources for public domain software and for some commercial software as well. Almost every computer has caused a torrent of software to be written for it and virtually all computer companies have encouraged software writers to market their products by listing themin a software catalog that can be purchased from your local computer dealer. These reference books are invaluable because they list the places where the programs can be ordered. Often you can persuade individual programmers who produce games to alter elements so they can be used by the blind.

There are a few large mail-order houses which have begun to offer collections of public-domain software at fairly reasonable prices.The Apple Avocational Alliance in Wyoming sells full disks of public domain software for between 2 and 3 dollars each. There are also discounts for bulk purchases. As you might have guessed,

most of their software has been written for the Apple. There are probably similar stores that deal with other computers, though I do not personally know of them.

TECHNIQUES FOR USING COMPUTER GAMES IN RECREATION PROGRAMS

The organization of computer use in recreation programs depends on a number of variables, most of which cannot be examined because they are determined by the game you are playing. This section will explore some general approaches and make some specific suggestions. Usually you will need to spend some time with at least some of the group, teaching the bare essentials of computer use. Though it might seem complicated, it is not and most people can be taught to use most computers well enough to play games within five or ten minutes. Aside from the freedom that having someone else operate the computer provides, teaching computer use to some or all of the group will probably encourage those you teach to use the computer when you are not there. You can also integrate the computer into a broader recreation program this way. If there is a table games period, the computer can become one of the most popular features. The computer is not only for the more advanced students. Less capable students may want to play bingo, for instance. Normally, they simply could not unless all the other students in the group chose to play. With a computer, you can set the game up and leave even the less able students to play it by themselves. When someone says "bingo" you can check the card by glancing at the computer screen where all the numbers will be displayed for easy checking.

Another approach would involve using the computer to occupy the more advanced students, while you concentrate your help and encouragement on the less able ones.

It is highly recommended that you start off with games that involve easily recognized speech like numbers so that your students can get used to the sound of the speech. Gradually, move on to games that involve the use of more words. Much more quickly than you would have believed possible, your students will be understanding even speech that you are having trouble picking up. Encourage as many of your students as possible to get hands-on experience with the computer. This will not only minimize jealousy, but will also promote peace and tranquility as each person waits for his turn.

Obviously, these techniques are simplistic and are not intended to be inclusive. Group involvement is easy to arouse at the outset because of the novelty of the computer. To maintain it is more difficult. It is ridiculous to expect every blind person to be a computer freak. There are likely to be a higher proportion

of people suffering from computer-phobia than is the norm because of the preponderance of negative attitudes that are common among those involved in the adjustment to visual loss. Because the computer enables the visually impaired to compete on equal terms in some games that have hitherto been impossible and because the skills that are being transferred during play can be applied in so many different areas of learning, the risk of a few ego-bruises is well worth taking.

ANCILLARY APPLICATIONS

In addition to the real advantages that the microcomputer can offer to students, there are some bonusses for the instructor as well. If recreation is to assume its rightful place in the hierarchy of adjustment training, its practitioners will need to publicize the impact of their efforts. The computer can be used to store data on your students and, by using such programs as visicalc, this data can be turned into viable statistical trends which can be used by you to plan your programs and can constitute the evidence of your program's impact that you need for publicity and to persuade administrators of the value of your work.

The planning process can be made much easier if you use a simple data-base type program with fields that designate such things as diabetes, visual acuity and secondary disabilities. Armed with this information, it is probable that many of the problems that diversity creates can be minimized. Reporting, too, can be easy if you store data codes for presence and performance on each student. It has the advantage that much of the subjectivity that tends to creep into the reporting process can be removed by the adoption of some standardized marking criteria.

When a network of computers becomes available at various rehabilitation facilities as it will sooner or later, games and systems that are developed at one center can be quickly shared with others. As the cost of computer networking falls, computers can be used for inter-center competitions.

There are a number of non-game applications for the students that should be mentioned as well. Too often, recreation is viewed outside the context of other learning that occurs during the adjustment process. If it is to assume a place of importance, it needs to integrate more effectively into the mainstream of adjustment. Student avocational involvement in letter-writing can be encouraged through the computer. The student can not only read back what he has written, but can also store addresses in simple databases from which he can retrieve them quickly and easily when he needs them. The same storage capacity applies to recipes, home inventories, talking books that have been read or any other

material that lends itself to sorting. The computer can also be used for such diverse activities as callory-counting and menu-planning; home and business budgetting; horoscopes and house-plant-raising; crochet-instruction or crossword puzzles; and, through networking, the computer can also be used to simply encourage conversation between people of like interests thousands of miles apart.

CONCLUSION

This paper has purposefully avoided any of the hype that can be found in any magazine you pick up these days. It has, instead, tried to offer straightforward, conservative information about the degree to which computers can become a part of any recreation program. There may be a good many heartaches at the outset of each group's involvement with computers and it may seem that, given all the problems and difficulties, the exercise simply isn't worth the commitment it will require of the recreation professional. On the other hand, if the hype means anything at all, the blindness system will ignore computer technology at its peril and at the peril of all of those clients it serves. This paper has, hopefully, opened the lines of communication with regard to integrating computers into recreation programs.

If it is to have any lasting value at all, you who begin to use computers must continue adding to the games list at the end of this paper. Also you must begin sharing this information with others in the recreation field and with other blind people with whom you come in contact.

The list of games at the end of this paper is by no means exhaustive, I hope. It represents the results of just a few months work on my part and on the part of others. I would particularly like to thank Nick Dotson for his help in the preparation of this list of games. Obviously, there are many hundred more games that are probably accessible; I just haven't discovered them yet. Many others need minor alteration to make them accessible. I don't have the skill to handle this but hope that some of you will look at games that almost work and find someone to make them accessible.

A maximum of one third of an individual's life on this planet is spent working. A survey of the clients you are serving right now would demonstrate that, for most of them, the other two-thirds of their allotted time is empty. The computer can do a tremendous amount to fill this void. You can do a lot to change the way blind people live with computers. The question is: will you?

TABLE OF GAMES

GAME	COMPUTER	STATUS	DESCRIPTION
Pyramid	trs 80	commercial	text adventure
Bedlam	trs 80	commercial	text adventure
Craps	apple	public	dice game.
Reverse	apple	public	number game
Quest	apple	public	short text game
Bagels	apple	public	number game
Taxman	apple	public	number game
Button	apple	public	simple guessing game
Hangman	apple	public	word-game
Esp Test	apple	public	mental powers test
Lunar Lander	apple	public	complex maths game
Dungeon	apple	public	maths quest
Kidnapped	apple	public	escape from building
Spelling	apple	public	word test
Eliza	apple	public	computer as shrink
End-zone	trs 80	public	football
Hangman	trs 80	public	word game
Bingo	apple	public	number-matching game
Animals	apple	public	make computer smart
Stoneville Manor	apple	public	treasure hunt
Craps	trs 80	commercial	dice game
Mastermind	apple	public	decoding game

Follow Me	apple	public	children's game
Hop-hopping	apple	public	children's game
People	apple	public	educate computer
Raaka-tu	trs 80	commercial	adventure game
Phone Words	apple	public	computer mnemonics
Apples	apple	public	economic simulation
Haunted House	trs 80	commercial	adventure game
Oregon Trail	apple	public	history simulation
Stars	apple	public	number game
Pork Barrel	apple	public	survive in Congress
Pet Pit Pat Pot	apple	public	children's game
A and An	apple	public	children's game
Keno	trs 80	commercial	gambling game
Scrambled Word	apple	public	anagrams
Cinquain	apple	public	computer poetry
Trap	apple	public	number game
Function Game	apple	public	algebra skills game
Cryptogram	apple	public	word codes
Baccarat	trs 80	commercial	card game
Craps	apple	public	dice game
B1 Bomber	apple	public	simulation game
Atom 20	apple	public	which-way game
Horse Race	apple	public	place your bets
Echo Blackjack	apple	public	card game
Roulette	trs 80	commercial	gambling game
Fort	apple	public	strategy game
Planet Miners	apple	public	galactic strategy

Dice	apple	public	dice game
Hammurabi	apple	public	city management
Simple Simon	apple	public	music-matching
Wheel of Fortune	trs 80	commercial	gambling game
Nightmare 6	apple	public	figure it out
Tarot	apple	public	fortune-telling
23 Bricks	apple	public	strategy with numbers
Seven	apple	public	card game
Russian Roulette	apple	public	live or die
Eamon	apple	public	adventure game
			42 adventures in set

LIST OF VENDORS

Apple Avocational Alliance, (public domain software for the Apple) 2111 Central Avenue, Cheyenne WY 82001

Apple Computers Inc. (for information on the 2, 2 plus and 2e computers) 10260 Bandley Drive, Cupertino CA 95014 (408) 996-1010

Appolo Lasers Inc. (large-print computer terminal), 6357 Arizona Circle, Los Angeles CA 90045, (213) 776-3343.

Computer Aids Inc. (for adaptive software for the blind including games; also sells complete Apple computer systems and publishes a news letter on speech-oriented programs for the blind) Post Office Box 5502 Fort Wayne IN 46895, (219) 424-4042.

Radio Shack, the Tandy Corporation (for information about the Model 1, 3, 4 and 100 computers) 1600 One Tandy Center, Fort Worth TX 76102 (817) 390-3011.

Raised Dot Computing (publishes an excellent interface guide for the Apple computer, a super news letter and wrote braille-edit, an excellent word-processing program for the blind) 310 South 7th Street, Lewisburg PA 17837, (717) 523-6739

Street Electronics (manufacturers of the Echo ii speech synthesizer) 1140 Mark Avenue, Carpinteria CA 93013, (905) 684-4593.

Telesensory Systems Inc. (manufacturers of the versabraille) 455 North Bernardo Avenue, Mountain View CA 93043, (415) 960-1212

Triformations Inc. (manufacturers of the microbrailler) 3132 South-east Jay Street, Stuart FL 33494, (305) 283-4817.

Visualtek Corp. (makers of large-print computer terminals and a special

electronic attachment for the Apple computer that produces large print) 1610 26th Street, Santa Monica CA 90404, (213) 829-6841.

Volunteer Services for the Blind (contact Fred Noesner for discount price on the echo ii speech synthesizer for blind individuals) 919 Walnut Street, Philadelphia PA 19107, (215) 627-0600

Votrax, a division of Federal Screw Works (manufacturers of the type an' talk and the personal speech system speech synthesizers) 500 Stephenson Highway, Troy MI 48084, (313) 841-8400, (800) 521-1350.